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REFORM IN THE TEACHING OF MATHEMATICS

LOUIS C. KARPINSKI
The University of Michigan

The international character of the movement toward reform in elementary teaching is attested by a commission to investigate the teaching of mathematics which is being formed at the direction of the International Congress of Mathematicians which met at Rome in April, 1908. The formation of such a commission was proposed in the Section of the Philosophy, History, and Pedagogy of Mathematics by Professor David Eugene Smith of Columbia University; the section recommended the appointment of such a body to the congress which empowered a committee consisting of Professor Felix Klein, Göttingen, president; Sir George Greenhill, London, vice-president; and Professor H. Fehr, Geneva, secretary, to appoint the commission. This committee reported in September to the Cologne meeting of the Deutsche Mathematiker Vereinigung the plan of organization of the commission. Representatives of Italy, Germany, France, England, the United States, Greece, Russia, Austria, Belgium, Denmark, Spain, Holland, Sweden, Hungary, Norway, Portugal, Roumania, and Switzerland are to form the executive body while representatives of practically all other civilized nations are invited to participate in the meetings of the organization. General direction is lodged in the original committee. It is proposed that the investigations begin immediately and that reports be made to the mathematical and educational societies of the various countries in order to permit of full discussion. Final reports are to be made to the next International Congress of Mathematicians at Cambridge, England, in 1912.

The scope of the work includes all schools in which mathematics is a subject of instruction, from primary schools to the university. The plan of studies, the systems of examinations, the methods of teaching, the preparation of teachers, laboratory methods in mathematics, the correlation among the different

branches of mathematics, and the correlation between the purely mathematical and the applied branches are all to be examined not only with regard to the actually existing conditions but also with a view to ascertaining the tendencies shown by the changes effected in the last two decades. Explicit statement is made in the preliminary report of the committee that it is not the aim of the commission to propose programmes which should be adapted to all countries but rather to suggest those general principles which should inspire the teacher. The American delegation in charge of the investigations in the United States consists of Professor William F. Osgood, of Harvard University, Professor David Eugene Smith, of Columbia University, and Professor J. W. A. Young, of the University of Chicago.

In the United States the National Educational Association attacked these questions as early as 1892 and 1893 through the well-known Committee of Ten and the Committee of Fifteen. More recently reports have been made on proposed changes to the Mathematics Section of the Central Association and the numerous state organizations of teachers of mathematics. In England the widespread Perry movement has had as its aim to make the work in mathematics more useful and practical. The French school curriculum has lately been revised, while in Austria and Germany recent reform committees of national and sectional learned societies are too numerous to mention.

For fifty years movements to humanize the work of the schools have been in progress. As a partial result of this effort nature-study, sewing, cooking, and like subjects have been introduced in the curriculum. Many educators believe that this method of humanizing the work, at least in the extent to which it is often carried, is too expensive of time and energy. The pupils scatter effort among so many studies that they obtain little real training. It need hardly be stated that training comes from consecutive application along one line of activity, be it carpentry or be it Latin. Tinkering is more destructive of ability in children than it is even in adults. Probably in the course of a few years a readjustment will eliminate or curtail in time subjects like cooking, sewing, and iron-work.

As elective in high schools or even in elementary schools these subjects could be made effective agents for training, but reading, writing, arithmetic, and geography must again occupy something like their old place in instruction. These older subjects, too, have been humanized—made vital and immediate. No re-adjustment can eliminate the beneficial effect on the general studies of the influences which brought the so-called practical studies into the curriculum.

It may not be amiss to recount some of the ways in which this humanizing effort has made itself felt in the various branches of elementary instruction.

In the study of English grammar can one imagine anything farther removed from literature and life than the work in parsing and diagramming? Today that work is abolished. The children write compositions on very prosaic and real subjects; actual trips to the woods, visits to factories, occurrences of vital interest to the children and things of which they have some real knowledge are described by them in their own words.

The work in geography begins not with the strange maps of some stranger lands but begins with talks about the rivers and hills and valleys of the child's own neighborhood. As that pioneer in nature-study, Dr. E. A. Sheldon, has said in regard to the study of geography:

The first duty by the way of laying a foundation is to lead the child to properly observe everything in nature about him—the air, the water, the sky, the clouds, the temperature, the animals, the plants, the rocks, the soil, the hills, the valleys, the streams, the habitations, the occupations—in short, all that pertains to that part of the earth which he knows and its environments.

From this the child goes out to county, state, country, and by natural steps to foreign lands.

The day of the spelling-book is passed; the child spells when he needs to spell and learns a given word when the need for that word arises in actual life.

The change from the alphabet system to the word and sentence method in reading is in entire accord with the new programme, even as the change from the old style of first, sec-

ond, third, fourth, and fifth readers to the beautifully illustrated and, to the child, intensely interesting, readers of the present day is a step from formalism to life.

The movement has not been simply to humanize the work in the sense of making it correspond to the work of adults but rather to vitalize the instruction by using material real to the child at his stage of development. Widespread and deep is the recognition of the fact that education is life, not preparation for life. Training is involved; life in the largest sense is the aim of the school and the development of high ideals of living is recognized as the teacher's function. Keeping this in mind there is no distinction between cultural and utilitarian aims. Capability of enjoying the best things in literature and art, ability to understand the great questions of the day and the small ones are powers which our schools must aim to cultivate.

The proposed reforms in mathematics are in harmony with the changes outlined in the other branches of study. The developments can be understood only in the light of the general movement.

A rational child-study leads in all the work to arithmetical problems which effect a correlation between nature-study, geography, history, and mathematics. The difficulties of the correlation are not yet cleared away but the newer texts show an admirable beginning. The slighted attempt to adapt the work to the child precludes the possibility of rules without reason. Nor does this programme eliminate drill work in abstract problems. The child in play naturally turns to rhythmic counting in many games as one outlet for his activity. Abstract work satisfies this natural instinct.

The Committee of Ten and the Committee of Fifteen both urged to abridge the course in arithmetic with an earlier introduction of algebra. This curtailment is in process in the discarding of compound proportion, arithmetical cube root and square root, and a great part of the so-called commercial arithmetic. All along the line complicated exercises (which in fact serve only to obscure fundamental principles) are cut out and simple exercises which emphasize the reasoning are substituted.

Again and again it is being noted that mathematical thinking as required by life is to be cultivated in the study of mathematics.

Hard and fast programmes of number work for the primary grades are disappearing. Complete suppression of number work is neither desired nor possible. The child is constantly confronted with the numerical side of life and the school can easily avail itself of these outside stimulations.

Connected series of problems on milk supply, on the school garden, on city distance in blocks—to cite only a few—offer abundant live material for number work in the primary grades. Family-expense accounts, statistics from census tables, transportation problems including electric railroads, steam railroads, and water routes, banking business, local industries, city, state, and national finances present problems that can be adapted to arithmetic work in the upper grades.

The artificial barriers between arithmetic and algebra are broken or breaking; happily no more will examiners request a solution “by arithmetic and not by algebra.” The elementary algebra work, while not so difficult as the arithmetic it is replacing, offers fully as much content.

The movement to teach geometry and algebra side by side is an attempt to emphasize mathematical reasoning; a similar effort to teach trigonometry in connection with the related theorems in geometry brings out the intimate connection between these two studies. The machinery of our school system is too complicated to permit such radical changes to be rapidly made; but a wider knowledge of these movements is needed among teachers of elementary mathematics.

The Commission on the Teaching of Mathematics has a tremendous task before it. The ground has been well prepared and an authoritative statement of the fundamental principles which should inspire the teacher of mathematics may expect a fruitful reception from enthusiastic teachers the world over.